Environmental history of European high mountains

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Guest Editorial

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This volume brings together 16 papers which investigate various aspects of high mountain areas, primarily in Europe.

Dietre et al. investigated the influence of settlement in the Silvretta Alps, Switzerland/Austria. The Silvretta Massif harbors more than 230 archaeological sites above 2000 m a.s.l., from Mesolithic to Modern Times, but received little attention in these matters up to recently. The Fimba Valley provides evidence of former human presence, as well as peat records allowing the reconstruction of Holocene climatic change and anthropogenic impact on past vegetation. Palynological evidence indicates extensive high *Pinus cembra* stands around the bog at 10,400 cal BP and between ca. 8600–6700 cal BP, more than 300 altitudinal meters above today's timberline, the highest population known for Central Europe. The palaeoecological results correlate well with the archaeologically known human impact during the Neolithic, Iron Age and Medieval periods. The exploitation of alpine landscape resources and livestock grazing has occurred at least for 6200 years in the Silvretta region.

Festi et al. combined an extensive archaeological survey and pollen analyses in the high altitudes of the Ötztal Alps to elucidate the palaeoenvironmental and past cultural implications that triggered the onset and development of seasonal transhumance and alpine summer farming. Pollen, NPP and micro-charcoal analyses were performed on three peat deposits and one lake sediment located near excavated archaeological sites arrayed along the traditional transhumance route. Pasture management at the high altitudes during the last 7000 years is revealed, beginning during the Bronze Age at the earliest.

Branch and Marini analyzed radiocarbon-dated palaeoecological records from the upland zone of the northern Apennines spanning the Mid-Late Holocene (last 7000 years) to detect anthropogenic impact. The records collectively indicate human interference with natural vegetation succession and landscape modification from at least the Middle Neolithic. Human activities resulted in the progressive decline of *Abies*, *Ulmus*, *Fraxinus* and *Tilia*, and the spread of *Fagus*, from ~7000 cal BP, accompanied by biomass burning, soil erosion, expansion of shrubland and herbaceous taxa, and the possible cultivation of *Olea, Juglans* and *Castanea*. The palaeoecological records broadly support the archaeological evidence, but suggest that several key vegetation changes also coincide with important periods of climate change, especially at ~7800–5000 cal BP.

Walsh et al. investigated the nature of human–environment interactions in the southern Ecrins, French Alps from the Mesolithic to the Post-Medieval Period. Palynology, pedo- and archaeo-anthracology, and archaeology were used to recognize phases of anthropological–ecological succession across the range of altitudes from valley-bottom to alpine. The Mesolithic was marked by the expansion of fir in the montane stage. The Neolithic saw low-altitude clearances, with hunting and low levels of human impact on high-altitude vegetation. The Chalcolithic/Bronze Age was marked by a complex interplay of climatic changes, and direct human intervention in the high altitude landscape. Although the Roman Period is characterised by phases of climatic amelioration after the deterioration of the Iron Age, an increase in human activity is not reflected in the sub-alpine and alpine altitudes. The Medieval Period saw a steady increase in human use of these landscapes, with forest manipulation and clearance.

Py et al. investigated the effect of silver–lead mining in the upper Durance valley of the French Southern Alps, using an archaeological, palynological, geochemical, anthracological and dendrochronological studies. The chronology is based on mining archaeology, radiocarbon dating of about thirty charcoal samples and the dendrochronological analysis of more than 170 specimens of exhumed waterlogged wood. The combination of palynological records and lead isotope imprints detected (i) a Roman contamination episode unknown to archaeology, (ii) the development of medieval mining activities and (iii) the reactivation of mining during the Modern period and the Industrial Revolution. Medieval mining coincided with an extension of the high mountain agropastoral areas. Human activities led to rational communal management of subalpine forests, but also to parcelling in the High Middle Ages. Mining during the Modern period coincided with significant stress on woodland areas. Mining reactivation during the 19th century was accompanied by the afforestation programme of the uplands.

Lopez Saez et al. present a review of the available Holocene pollen records from the Spanish Central System. Palynological data were used to infer the human impact on vegetation and landscape during the last 9 millennia. The Neolithic contribution to the configuration of landscape is limited to the valleys. Chalcolithic settlements, agriculture, and grazing represent the first evidence of significant human impact on the high-mountains. The Copper Age-Early Bronze Age and Late Bronze Age–Early Iron Age transitions are related to abrupt climate disruptions, the 4.2 and 2.8 ka cal BP events respectively. From the Iron Age to the Early Middle Ages, anthropic activities were sporadic. From the Feudal Period onwards with the La Mesta trashumance system, high-mountain landscapes changed dramatically. The Late Modern Period brought further intensification of human pressure, with widespread pinewood afforestation.

Countrasts Bog, Mont Lozère medium mountain, was the subject of an interdisciplinary study by Servera Vives et al., combining multiproxy analyses which includes pollen, non-pollen palynomorphs (NPP), macrocharcoal particles, sedimentology geochemistry, archaeological and archaeobotanical data. The landscape dynamics for the last 2000 years were investigated at a micro-regional scale.

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Local agropastoral and metallurgical activities occurred during Roman time. During the Late Antiquity and Early Medieval periods, agropastoral activity increased, and human impact resulted in the replacement of birch by sedge communities. During the High Middle Ages, land uses included smelting, forestry, and agropastoralism. Decline in mining and forestry in the Late Middle Ages (ca. 14th century AD) coincided with the expansion of grazing, triggering the establishment of an open-landscape during the Early Modern Period.

Orengo et al. conducted a multidisciplinary micro-regional landscape research project in the Madriu-Perafita-Claror valleys of the Eastern Pyrenees, Andorra. Fifty-five archaeological structures were excavated, accompanied by multiproxy study of seven palaeoenvironmental sequences. Early Neolithic small groups practised a diversified economy involving grazing, hunting, fishing, gathering, and incipient cereal agriculture. They frequented diverse altitudinal belts in order to take advantage of different resources. The Middle/late Neolithic human groups show a higher degree of sedentism, with agriculture, animal husbandry, and the first use of fires to create grazing areas. During the Chalcolithic, human landscape use caused significant landscape changes, including deforestation by fire and intensive agriculture.

Martín et al. identified carnivore consumption in Holocene horizons of El Mirador Cave, Sierra de Atapuerca, Spain, including domestic dogs, wild cats, badgers, and foxes. The evidence includes cut marks, bone breakage, signs of culinary processing, and human tooth marks. This is some of the oldest evidence documented in Europe, and the first time that human tooth marks were used to confirm the human consumption of these carnivores. Dog consumption was sporadic but occurs repeatedly in time, whereas the consumption of small wild carnivores was more limited. These practices could be linked with the provision of extra food during periods of shortage and/or with meat for particular purposes.

García-Medrano et al. analyzed the oldest Acheulean lithic assemblages from the Galería site, dated to ca. 503 ± 95 ka, to produce a detailed technological characterization of the earliest Acheulean presence in Atapuerca. The Galería site was a cave which was accessed by both humans and carnivores in order to utilize herbivores that had fallen through a natural shaft. The archaeological record is incomplete and fragmented, since it is the product of highly changeable occupational dynamics. The lower Galería levels show a transition from an almost exclusive use of cobbles as blanks for knapping activities in the earliest periods to an increasing use of flakes. Comparison of older and younger Acheulean assemblages involves consideration of the significance of cobbles and flakes as blanks, the significance of cleavers; and the use of raw materials.

Navazo and Carbonell undertook an archaeological survey in Sierra de Atapuerca, in order to develop a full-coverage and high-intensity fieldwork methodology that would permit the discovery of all prehistoric settlements, and to document and study the Upper Pleistocene. Results from 31 Middle Palaeolithic sites confirm the inhabitation of Sierra de Atapuerca in MIS 4–3 and show settlement patterns of hunter–gatherer groups which inhabited the region in the Upper Pleistocene.

Oliva et al. integrate and summarize all the studies focused on the reconstruction of the palaeoenvironmental history in the Sierra Nevada of Spain since the Last Glaciation. Geomorphological, sedimentological and geochronological techniques were used to characterize the glacial, periglacial, wetland and lacustrine palaeoenvironmental records. Based on a multi-proxy approach, five periods have been identified: Last Glaciation, deglaciation, Holocene, Little Ice Age and recent evolution. The maximum expansion of glaciers in the Sierra Nevada occurred around 30–32 ka BP. Around 19–20 ka BP, the glaciers readvanced. The process of deglaciation was rapid and around 14–15 ka BP the massif was almost free of ice. The Late Glacial saw the formation of small glaciers in the highest northern cirques and widespread active periglacial processes. During the Holocene there has been an alternation of colder/warmer periods and changing moisture conditions. Ephemeral reappearance of small glacial cirques occurred in the highest northern cirques during the coldest and wettest phases, including the Little Ice Age. Since the end of the 19th century, temperature increase leads a decrease of the intensity of periglacial processes.

Jurickova et al. investigated the Holocene mollusc and vertebrate fauna of the Sudetes Mountains. The Holocene mollusc succession follows a similar course to that of the standard central European Holocene succession with regional differences. Some woodland species survived the Glacial in talus slope debris with suitable microhabitats. The structure of the vertebrate assemblage suggests that the valleys of Krkonoše Mts. might have provided favourable conditions for a diversified mammalian community during glaciation. Isolated occurrences of Alpine and Carpathian faunal elements are not relics of a former, much wider distribution, but immigrated after the mid-Holocene. The Western Sudetes generally had low mollusc diversity throughout the Holocene.

Žebre and Stepišnik investigated Pleistocene glaciations in the Dinaric Alps. Detailed morphographic evidence of glaciations on Mount Lovćen is presented, along with a reconstruction of paleoglacier dimensions and estimates of the paleo-equilibrium line altitude. Mapping of glacial landforms on Mount Lovćen revealed at least two different glacial events. The reconstruction of glacier dimensions and ELA were only performed for the younger glaciations, which extended over an area of at least 39.9 km^2 and reached a maximum thickness of about 290 m. The regional ELA for the Mount Lovćen glaciers was 1259 m.

Ebrahimi and Seif undertook morphometric analysis using DEM on the main cirque-like features in the Zardkuh Mountains, central Zagros Mountain Range, Iran. All the cirque-like features were classified based on results of the power function model and comparison of longitudinal profiles of the cirque like-features with the Vilborg and Evans classification system. At least 9 cirques with the classical characteristics were distinguished above 3650 m a.s.l. In addition, the morphometric parameters of 28 cirques (with most glacial characteristics) and their allometric behaviors were analyzed and compared with similar research.

Alexandrowicz et al. conducted detailed malacological analysis on calcareous tufa occurring in the Podhale Basin, Carpathians, southern Poland. Five sites contain Late Glacial and Holocene tufa, and ten have tufa deposited during historical times. On the basis of malacological analysis, 10 faunistic assemblages were defined. The faunal sequence indicates cold climate and the predominance of open habitats in the Late Glacial, with progressing warming and increasing significance of shaded habitats in the Early and Middle Holocene, as well as anthropogenic pressure in modern times. The reconstruction indicates similarities and differences in the paleogeographic development of mountain and upland areas of Central Europe.

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